

DATA COMMUNICATION METHOD AND DATA COMMUNICATION SYSTEM,  
AND BATTERY CHARGING APPARATUS AND METHOD

## Field of the Invention

This invention relates to a data communication system and method through which a controller and a controlled device controlled by the controller perform data communication via a communication channel, and to the controller and controlled device that construct this data communication system. The invention relates further to a digital video camera and printer. The invention relates further to a method of controlling the storage of driver software and a method of reading out the driver software.

This invention relates further to a battery charging apparatus capable of being connected to a communication apparatus, which is capable of performing data communication via a communication channel, using this communication channel to make the connection. The invention relates further to a method of charging a battery.

25        In a data communication system through which a  
controller (a personal computer) and a controlled device  
(a printer or digital video camera, etc.) perform data  
communication via a communication channel, it is

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Accordingly, a first object of the present invention is to so arrange it that installation of driver software (a program for controlling an

A second object of the present invention is to provide a battery charging apparatus capable of being connected to a communication apparatus, which is capable of performing data communication via a communication channel, using this communication channel to make the connection, as well as a battery charging method.

A first invention is to provide a data communication method through which a controller and a controlled device controlled by the controller perform data (inclusive of image data and audio data) communication via a communication channel.

In accordance with this data communication method, driver software of a plurality of types is stored in a storage area of the controlled device (e.g., a digital video camera or a printer).

The controller judged whether driver software suited to the controller has been stored in a predetermined first storage area of the controlled device. In response to a judgement by the controller to the effect that driver software suited to the controller has been stored in the controlled device, the driver software suited to the controller is read out of the first storage area, data representing the driver software read out is transmitted from the controlled device to the controller, and the transmitted data

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Sub representing the driver software is stored in a second storage area of the controller.

A first aspect of the present invention is to provide a data communication system suitable for  
5 implementing the data communication method described above.

The data communication system according to the present invention is for communication of data between a controller and a controlled device via a communication  
10 channel.

The controlled device is provided with a first memory capable of storing driver software of a plurality of types.

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The controller comprises a second memory for  
15 storing driver software, judgement means (a judgement device) for judging whether driver software suited to the controlled device has been stored in a predetermined first storage area of the first memory, readout means (a readout device), responsive to a judgement by the  
20 controller to the effect that driver software suited to the controller has been stored in the controlled device, for reading the driver software suited to the controlled device out of the first storage area, transmission control means (a transmission control device) for  
25 transmitting data, which represents the driver software read out by the readout control means, from the controlled device to the controller, and storage control means (a storage control device) for receiving the data

B1 representing the driver software transmitted by the transmission control means, and storing this data in a second storage area of the second memory.

The controller or controlled device constructing  
5 the data communication system described above may each be constructed as a stand-alone device.

In accordance with the first aspect of present invention, driver software of a plurality of types is stored in the controlled device described above. It is  
10 judged whether driver software suited to the controller which performs data communication with the controlled device has been stored among the plural types of driver software. If driver software suited to the controller has been stored, this driver software is read out of the  
15 controlled device and transmitted to the controller. The transmitted driver software is stored in the controller to complete installation.

In accordance with the first aspect of present invention, the labor involved in installing driver  
20 software, which is for performing data communication with a controlled device, in the controller is eliminated. Installation of the driver software can be executed without a troublesome operation being required of the user. In addition, driver software not suited to  
25 the controlled device can be prevented from being installed in the controller.

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~~An arrangement may be adopted in which it is judged beforehand whether driver software suited to the~~

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controller has not been stored in the controller, and in response to a judgement to the effect that the driver software has not been stored, it is judged whether driver software suited to the controller has been stored  
5 in the first storage area of the controlled device.

If, upon judging whether installation of driver software is required or not, it is found that installation is required, then installation is carried out. This makes it possible to prevent the re-  
10 installation of driver software that has already been installed.

It is preferred that in response to a judgement to the effect that driver software suited to the controller has not been stored in the first storage area of the  
15 controlled device, information relating to the result of the judgement is communicated to the user.

As a result, the user can be notified of the fact that driver software cannot be transmitted from the controlled device to the controller, as a result of  
20 which processing for installing the driver software cannot be executed. In this case, the user would load a floppy disk or the like, which stores the driver software suited to the controller, into the controller to perform installation of the driver software.

25 The above-mentioned communication line may be a cable in accordance with the IEEE (Institute for Electrical and Electronic Engineers) 1394 standards, and data representing the driver software may be transmitted

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in accordance with IEEE 1394. As a result, the data representing driver software can be sent and received at a comparatively high speed. Installation of the driver software is speeded up as a result.

5           It is preferred that the driver software stored in the controlled device be rewritable. This would make it possible to update the driver software.

          It is preferred that the address of driver software that has been stored in the first storage area and  
10   information (the operating system used by the controller, etc.) relating to the controller capable of performing control using this driver software be stored so as to be capable of being read out.

          By thus reading out the above-mentioned address as  
15   well as the information relating to the controller, the driver software can be read out again in comparatively simple fashion.

          As many apparently widely different embodiments of the present invention can be made without departing from  
20   the spirit and scope thereof, it is to be understood that the invention is not limited to the specific embodiments thereof except as defined in the appended claims.

          According to a second aspect of the present  
25   invention, there is provided a charging apparatus capable of being connected to a communication apparatus, which is capable of performing data communication via a communication channel, using this communication channel

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to make the connection, wherein the communication channel includes a communication line for data communication and a power supply line for supplying electric power, the apparatus having a charging circuit  
5 for charging a battery by being supplied with electric power through the power supply line.

According to the second aspect of the invention, there is also provided a method suited to the charging apparatus defined above.

10 Specifically, a method of charging a battery according to the present invention comprises connecting a charging apparatus, which includes a charging circuit, to a communication apparatus capable of performing data communication via a communication channel that includes  
15 a communication line for data communication and a power supply line for supplying electric power, the connection being made using the communication channel, and charging a battery by supplying electric power to the charging circuit through the power supply line.

20 In accordance with the second aspect of the invention, the charging apparatus can be connected to a communication apparatus, which is capable of performing data communication via a communication channel, using the communication channel. The communication channel  
25 includes a communication line for data communication and a power supply line for supplying electric power. Supplying the charging circuit with electric power through the communication line makes it possible to

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charge a battery. A power supply cable need not be connected separately of the communication channel.

Preferably, it is judged, based upon the power supplying capability of the communication apparatus,  
5 whether charging by the charging circuit is possible, and charging the battery by the charging circuit in response to a judgement to the effect that charging is possible.

10 Preferably, it is judged, based upon the level of electric power supplied from the power supply line, whether a decline in supplied power will occur in the power supply line, and performing an adjustment to reduce amount of charging by the charging circuit in response to a judgement to the effect that a decline in  
15 the supplied power will occur.

When the power supplying capability is low, it is possible to prevent data communication from being interrupted by a decline in supplied power caused by charging being carried out by the charging circuit.

20 According to a third aspect of the present invention, there is provided a charging apparatus capable of being connected to a communication apparatus, which is capable of performing data communication via a communication channel, using this communication channel  
25 to make the connection, wherein the communication channel includes a communication line for data communication and a power supply line for supplying electric power, the apparatus having a charging circuit

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for applying electric power, with which it is supplied through the power supply line, to a connector of a data processing unit driven by an installed battery, the data processing unit being formed to have the connector in  
5 order to input electric power for charging the battery.

According to the third aspect of the invention, there is also provided a method suited to the charging apparatus defined above.

Specifically, there is provided a method of  
10 charging a battery using a charging apparatus capable of being connected to a communication apparatus, which is capable of performing data communication via a communication channel, using this communication channel to make the connection, wherein the communication  
15 channel includes a communication line for data communication and a power supply line for supplying electric power, the method including applying electric power, which is supplied through the power supply line, to a connector of a data processing unit driven by an  
20 installed battery, the data processing unit being formed to have the connector in order to input electric power for charging the battery, the battery being charged by the electric power applied.

In accordance with the second aspect of the  
25 invention, a battery can be charged while still installed in a data processing unit driven by the installed battery.

Other features and advantages of the present

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invention will be apparent from the following description taken in conjunction with the accompanying drawings, in which like reference characters designate the same or similar parts throughout the figures thereof.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram illustrating the electrical configuration of a communication system according to a first embodiment of the present invention;

Fig. 2 illustrates the content of an EEPROM included in a device, namely the content of a bus information block and root directory;

Fig. 3 illustrates the content of an EEPROM included in a device, namely the content of a unit directory;

Fig. 4 illustrates the content of an EEPROM included in a device, namely the content of a unit-specific information directory;

Fig. 5 illustrates the content of an EEPROM included in a device, namely the content of a driver-software information directory;

Fig. 6 illustrates the content of an EEPROM included in a device, namely the content of a driver-software archive area;

Fig. 7 is a flowchart illustrating the procedure of processing for installing a device driver;

Fig. 8 is a block diagram illustrating a second

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embodiment of the present invention and showing a charging apparatus, a personal computer and a communication apparatus interconnected by a cable in accordance with IEEE 1394;

5        Fig. 9 illustrates the format of a self-identification packet; and

Fig. 10 is a block diagram illustrating another embodiment of the present invention and showing a charging apparatus, which is connected to a digital camera, and a personal computer connected to the charging apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENT

(1) First embodiment

A preferred embodiment of the present invention will now be described with reference to the drawings.

Fig. 1 is a block diagram illustrating the electrical configuration of a communication system according to a first embodiment of the present invention.

20        In this communication system, a device 20 (a printer or digital video camera, etc.) and a device controller 10 for controlling the device 20 are connected by a cable in accordance with IEEE 1394.

The device controller 10 has its overall operation supervised by a CPU 13. The device controller 10 includes a communication control circuit 11 for performing a data transfer in accordance with IEEE 1394, a display unit 14 whose display is controlled by the CPU

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13, and a memory 15 for storing an operation program and other necessary data.

The device 20 has its overall operation supervised by a CPU 23.

5       The device 20 includes a communication control circuit 21 in such a manner that data transfer in accordance with IEEE 1394 is possible. The communication control circuit 21 is connected to the CPU 23 via a bus bridge 22. The device 20 further includes  
10   an EEPROM 24 storing driver software for controlling the device 20 by the device controller 10, as well as other data (the details of which will be described later), and a main memory 25 for temporarily storing data (image data, audio data, etc.) transmitted from the device  
15   controller 10.

Figs. 2 through 6 illustrate content stored in the EEPROM 24 of the device 20.

Fig. 2 illustrates the content of a bus information block and root directory, Fig. 3 illustrates the content  
20   of a unit directory, Fig. 4 illustrates the content of a user-specific information directory, Fig. 5 illustrates the content of a driver-software information directory and Fig. 6 illustrates the content of a driver-software archive area.

25       As shown in Fig. 2, a bus information block stores a flag indicating the size of the bus information block, data indicating CRC (cyclic redundancy check) data length, a CRC value of the EEPROM 24, bus name (since

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the device 20 and device controller 10 are connected by a cable in accordance with IEEE 1394 in this embodiment, this fact is stored here), data representing whether communication of isochronous data is allowed or not, a reserve area, speed of the cycle clock of a cycle master (here the device controller 10 is the cycle master), payload size of isochronous data, printer maker ID and interface hardware ID.

The root directory stores a flag indicating the size of the root directory, a CRC, an interface module maker ID and its data index (the data index is an item of data which represents what the following item of data is), a flag indicating the capability of a node (here the device 20), the address of a node-unique ID (which includes the maker ID and serial number of the node) and the address of the unit directory.

As shown in Fig. 3, the unit directory stores a flag indicating the size of the unit directory, a CRC, a device maker ID and its index, the software version of the system controller of the printer and its index, and the address of the unit-specific information directory and its index.

As shown in Fig. 4, the unit-specific information directory stores a flag indicating the size of the unit-specific information directory, a CRC, a command address, and its index, used when a command is transmitted from the device controller 10 to the device 20, device maker name and its index, device model name

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and its index, and the address of the software information directory and its index.

As shown in Fig. 5, the driver-software information directory stores the data length of the data that has  
5 been stored in the driver-software information directory, a CRC, the corresponding OS (operating system) name of the driver software and its major version number and minor version number, and the storage address of the driver software. Since driver software  
10 of a plurality of types has been stored in the driver-software archive area, as will be set forth below, a corresponding OS name of the driver software, major version number, minor version number and driver software storage address also are stored in dependence upon the  
15 type of driver software.

A plurality of types of driver software are stored in the driver-software archive area illustrated in Fig. 6. Driver software of types "A", "B", "C" and "D" are stored in areas specified by addresses ad1, ad2, ad3 and  
20 ad4, respectively. Thus, in the communication system according to this embodiment, a plurality of types of driver software are stored in the driver-software archive area, and driver software suited to the operating system used in the device controller 10  
25 connected to the device 20 is read out. The processing involved will be described in detail later.

Installation of driver software in the device controller 10 according to this embodiment will now be

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described.

Fig. 7 is a flowchart illustrating the processing procedure for installing driver software.

With reference to Figs. 7 and 1, the maker name and  
5 model name of the device 20 connected to the device  
controller 10 are read (step 31). In order to read this  
information, first reference is had to the root  
directory shown in Fig. 2, whence the address of the  
unit directory is sensed. The unit directory is  
10 referred to based upon the address of the unit  
directory. The address of the unit-specific information  
directory is sensed from the unit directory. The unit-  
specific information directory is referred to based upon  
the address of the unit-specific information directory.  
15 The device maker name and device model name are sensed  
from the unit-specific information directory. The data  
representing sensed device maker name and device model  
name is read out of the EEPROM 24 and supplied from the  
device 20 to the device controller 10. The data  
20 representing the device maker name and device model name  
is stored temporarily in the main memory 15 of the  
~~device controller 10.~~

Next, it is judged whether driver software suitable  
for controlling the device 20 connected to the device  
25 controller 10 has been stored in the main memory 15 of  
device controller 10 (step 32). If the driver software  
has already been stored in the main memory 15 ("YES" at  
step 32), processing for installing the driver software

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If it is judged that driver software suited to the device controller 10 has been stored in the device 20, the storage address of the suitable driver software is

If it is judged that driver software suited to the device controller 10 has been stored in the device 20, the storage address of the suitable driver software is

sensed from the driver-software information directory.  
Data representing the driver software suited to the  
device controller 10 is read out of the driver-software  
archive area based upon the sensed address. The data  
5 representing the driver software that has been read out  
is transmitted from the device 20 to the device  
controller 10 in accordance with IEEE 1394 (step 34).

The data representing the driver software is  
received by the device controller 10 and stored in the  
10 main memory 15. This completes the installation of the  
driver software. Reading out the driver software that  
has been stored in the main memory 15 makes it possible  
for the operation (a printing operation, image data  
reading operation, etc.) of the device 20 to be  
15 controlled by the device controller 10.

If driver software suitable for control of the  
device 20 has not been stored in the EEPROM 24 of the  
device 10 ("NO" at step 33), then a message to this  
effect and a message calling for installation of the  
20 driver software are displayed on the display unit 14 of  
the device controller 10 (step 35). In response, the  
user loads a storage medium such as a floppy disk  
storing the driver software suitable for control of the  
device 20 into the floppy disk driver (not shown) of the  
25 device controller 10, thereby performing installation.

In the embodiment described above, data transfer of  
the driver software is carried out based upon IEEE 1394.  
However, it goes without saying that the data transfer

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may be performed based upon another standard.

If the device 20 in the above-described embodiment is a digital video camera, plural types of driver software would be stored in the digital video camera and the driver software suitable for controlling the camera would be read out of the camera and transmitted to the camera controller (device controller). If the device 20 is a printer, then plural types of driver software would be stored in the printer and the driver software suitable for controlling the printer would be read out of the printer and transmitted to the printer controller (device controller).

Further, in the embodiment described above, driver software suited to the device controller 10 is transmitted from the device 20 to the device controller 10. However, data representing the address of the location storing this driver software and data representing the operating system for operating this driver software may be transmitted to the device controller 10 in addition to the driver software. This will make it possible to read out the driver software again merely by referring to these items of data, ~~speedy~~.

(2) Second embodiment

Fig. 8 illustrates a second embodiment of the present invention.

As shown in Fig. 8, a charging apparatus 40, a personal computer 60 and a communication apparatus 70

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are interconnected by a cable 50 in accordance with IEEE 1394. The cable 50 includes a signal line 52 for transmitting data and a power supply line 51 for supplying electric power. The cable 50 includes a  
5 ground line as well, though this is not shown. Though there are four signal lines in actuality, here only one is shown in order to simplify the drawing.

The overall operation of the charging apparatus 40 is supervised by a CPU 41. A ROM 42 storing data to be  
10 sent to and received from the personal computer 60 is connected to the CPU 41. A communication control circuit 45, which is for sending and receiving data in accordance with IEEE 1394, is also connected to the CPU 41. The communication control circuit 45 is connected  
15 to the signal line 52.

The charging apparatus 40 includes a charging circuit 43 for charging a battery 48. The charging circuit 43 is connected to the power supply line 51 and charges the battery 48 by electric power supplied from  
20 the power supply line 51. The power supply line 51 is connected to a monitoring circuit 44 as well in order that the electric power supplied from the power supply line 51 may be monitored. Data representing the status of the electric power (i.e., where it is equal to or  
25 greater than a fixed level) supplied from the power supply line 51 is applied from the monitoring circuit 44 to the CPU 41. It should be noted that a cable for supplying electric power from an external power source

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is not connected to the charging apparatus 40.

The overall operation of the personal computer 60 is supervised by a CPU 61.

The personal computer 60 also includes a  
5 communication control circuit 63 capable of sending and receiving data in accordance with IEEE 1394 and connected to the cable 50. The communication control circuit 63 is controlled by a controller 62. The controller 62 is controlled by the CPU 61.

10 The personal computer 60 includes a power source unit 64. By plugging an AC plug 65 into the socket of a commercial power supply, 120-volt AC voltage is applied to the power source unit 64. The power source unit 64 converts the 120-volt AC voltage to a DC voltage of 8 to  
15 40 volts. The power source unit 64 also is connected to the power supply line 51. The converted DC voltage of 8 to 40 volts is supplied to the power supply line 51, whereby the DC voltage is supplied as power for driving the charging apparatus 40 and communication apparatus 70  
20 connected by the cable 50. It goes without saying that the DC voltage obtained by the conversion in the power source unit 64 is supplied as driving voltage to each of the components of the personal computer 60.

The operation through which charging is carried out  
25 by the charging apparatus 40 will now be described.

Whether the cable 50 in accordance with IEEE 1394 has been connected between the charging apparatus 40 and personal computer 60 or not is monitored by the

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First through fourth self-identification packets are transmitted in dependence upon the number of ports to which the cable 50 is connected. Here it is assumed for the sake of simplicity that one self-identification packet is transmitted.

As shown in Fig. 9, an area 10 of the packet stores the identifier of the self-identification packet, an area phy ID stores an identifier specific to the apparatus that transmits this self-identification packet, an area 0 stores data indicating that this is the first self-identification packet, an area L stores data indicating whether the communication control circuit of the apparatus that transmits the self-identification packet is in a state in which it can receive data, an area gap cnt stores data relating to a threshold value used in judging a sub-action gap and an arbitration gap, etc., in data transfer in accordance with IEEE 1394, an area sp stores data representing

capability relating to data communication speed, an area  
del stores data relating to delay time which occurs in a  
case where an apparatus that has received data transfers  
the data to another apparatus, an area c stores data  
5 representing whether a bus manager and isochronous  
resource manager can be implemented in data transfer in  
accordance with IEEE 1394, an area pwr stores data  
indicating whether this apparatus has the ability to  
supply electric power, as well as data indicating  
10 maximum power consumption, areas p0 to p2 store data  
relating to whether another apparatus is connected to  
the port of this apparatus as a higher order apparatus  
or as a lower order apparatus hierarchically speaking,  
an area i stores the self-identification packet of the  
15 apparatus which began bus reset first, which packet  
includes data relating to this fact, and an area m  
stores data indicating whether a self-identification  
packet is to follow.

Self-identification packets of this kind are  
20 transmitted between the charging apparatus 40 and  
personal computer 60 at occurrence of bus reset. When  
the charging apparatus 40 receives the self-  
identification packet transmitted from the personal  
computer 60, the charging apparatus 40 senses the power  
25 supplying capability of the personal computer 60 stored  
in the area pwr of this self-identification packet. The  
sensed power supplying capability and the maximum power  
consumption of the charging apparatus 40 (the relevant

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The personal computer 60 also compares the maximum power consumption and power supplying capability stored in the area pwr of the self-identification packet transmitted from the charging apparatus 40. If  
5 required, the personal computer 60 terminates the supply of electric power to the charging apparatus 40.

It goes without saying that data (e.g., data relating to the state of charging) is sent and received by the charging apparatus 40 and personal computer 60 in  
10 Fig. 8 through the signal line 52 included in the cable 50.

Fig. 10 is a block diagram illustrating another embodiment of the present invention and showing a charging apparatus 40A, which has been connected to a  
15 digital camera (data processing unit) 80, and the personal computer 60 connected to the charging apparatus 40A by the cable 50 in accordance with IEEE 1394. Components identical with those shown in Fig. 8 are designated by like reference characters and are not  
20 described again.

The charging apparatus 40A shown in Fig. 10 is formed to have connectors 46 and 47 by which the charging apparatus 40A and the digital camera 80 are electrically connected to each other. Electric power  
25 supplied from the charging circuit 43 is applied to the connectors 46. The connector 47 is connected to the CPU 41.

The digital camera 80 includes a controller 81 and

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sends and receives data to and from the charging apparatus 40A via the connector 47. (Though the digital camera 80 includes a variety of circuits, they are not illustrated here as they have no direct bearing upon the present invention.) The battery 48 serving as the driving power supply is installed in the digital camera 80. The two ends of the battery 48 are connected to the connectors 46.

By thus connecting the charging apparatus 40A to the digital camera 80, the battery 48 installed in the digital camera 80 can be charged using the charging circuit 43 included in the charging apparatus 40A.

As many apparently widely different embodiments of the present invention can be made without departing from the spirit and scope thereof, it is to be understood that the invention is not limited to the specific embodiments thereof except as defined in the appended claims.

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